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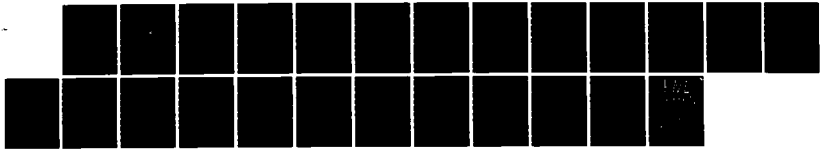

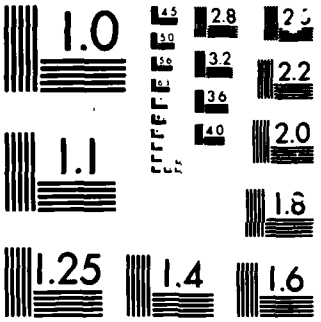

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PREDICTING CONTRACTOR FINANCIAL STABILITY:

NEW INSIGHT FOR SOURCE SELECTION

by

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and

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Although a relatively small percentage of the total number of contracts awarded by the Federal Government, contracts terminated for financial reasons can be very costly to the government. This study investigated the feasibility of developing a reliable contractor bankruptcy prediction model. This report begins with a brief discussion of the source selection process, followed by a discussion of the need for a contractor bankruptcy prediction model. A reliable model was developed and validated with real world cases. We conclude that significant cost savings can be realized if our model is utilized during the source selection stage of contracting.

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PREDICTING CONTRACTOR FINANCIAL STABILITY: NEW INSIGHT FOR SOURCE SELECTION

One of the major issue in contract management that has been neglected by acquisition analysts is the termination of contracts for financial reasons. Although contracts terminated for financial reasons account for a relatively small percentage of the total number of contracts awarded by the Federal Government, they can be very costly to the government. At the request of the Department of the Army, we investigated the feasibility of developing a reliable contractor bankruptcy prediction model. This paper summarizes the results of our study.

This paper begins with a brief discussion of the source selection process, followed by a discussion of the need for a contractor bankruptcy prediction model. A reliable model was developed and validated with real world cases. We conclude that significant cost savings can be realized if our model is utilized during the source selection stage of contracting.

SOURCE SELECTION PROCESS

When selecting a contractor to fulfill the requirement of a Federal Government contract, no bias should enter into the selection process. Prior to contract award, prospective contractors are evaluated in two broad categories: responsiveness and responsibility.

The determination of responsiveness involves a review by the contracting officer of the business aspects of the submitted bid/offer. This portion of the evaluation is concerned with

whether or not the contractor (1) is in conformity with all contract terms, (2) is in agreement with the delivery schedule, or (3) has made any adjustments or qualifications to the original contract.

The evaluation of responsibility involves a review of the contractor's operations and qualifications. Information is gathered from both the contractor and government sources in order to make a determination as to whether or not the contractor will be able to deliver in accordance with the responsive claims. Some of the major areas of particular interest are:

(1) financial stability,

(2) contractor's performance record,

(3) contractor's integrity record,

(4) conformity to equal opportunity regulations, and

(5) eligibility and qualification to fulfill contract requirements.

In evaluating the ability of a contractor to conform to responsive and responsible attributes, the Procurement Contracting Officer (PCO) requests a pre-award survey. This involves an in-depth review of the contractor by an Administrative Contract Officer (ACO) from a Defense Contract Administrative Services Management Area (DCASMA). Among other things, the ACO, along with a team of specialists, is responsible for evaluating the ability of any proposed contractor to comply with the elements of the contract through completion. After the evaluation is completed, each area evaluated (financial, technical, productivity, quality

assurance, accounting system) receives a rating of satisfactory or unsatisfactory. Any unsatisfactory rating automatically results in an overall recommendation of "no award" of the contract. Consequently, the next higher bidder (assuming a satisfactory pre-award survey) would be awarded the contract.

TERMINATIONS FOR DEFAULT

As part of the provisions in a contract, the Government has the right to terminate the contract either (1) due to default by the contractor or (2) for the convenience of the Government, depending on the circumstances. The latter is in the Government's interest and, therefore, will not be addressed in this paper. The former, however, can be very costly to the Government and therefore deserves a systematic study at the earliest stage of procurement process in order to avoid potential loss.

A Government contract is terminated for default when it has been determined that the contractor is in breach of contract and no longer capable of fulfilling the requirements of the contract. Default terminations are usually enacted as a last resort, after the contractor has been given an opportunity to improve or correct any delinquent portion of the contract. When the contractor faces bankruptcy, however, the inevitable result is contract termination by default.

Several problems develop when a termination for default is enacted. First, if any advance or progress payments have been paid to the contractor for work not yet performed, they must be

recouped (usually through litigation). Second, a new contract must be negotiated with a new supplier and any difference in price must also be recouped from the defaulted contractor. Third, many contractors take the Government to court, claiming breach of contract by the Government, thus tying up the process even further. Fourth, while all this is happening the contract remains unfilled and defense readiness is compromised.

Default termination for financial reason is the most costly of all. Apart from the litigation cost, the amount the Government is supposed to recoup (progress payment, price difference, etc) is most likely uncollectable, as an insolvent contractor is not financially capable of paying.

A further complication is that a potential contractor approaching bankruptcy is more likely to submit a low bid, hoping that the extra business from winning a contract may turn things around. However, bankruptcy is the result of a host of factors. Winning an extra Government contract does not assure business survival. It simply complicates the problems faced by Government procurement managers. Therefore, the potential cost to the Government can be staggering if a potential contractor approaching bankruptcy is not screened out in the source selection process. The remainder of the paper deals with the method of identifying potential contractors facing potential bankruptcy.

OVERVIEW OF FINANCIAL ANALYSIS

The basic financial statements, balance sheet and income statement, can provide a great deal of information about the financial well-being of a firm, but certain analysis must be performed before an analyst can extract useful information for a specific purpose. For our purpose, we will examine the feasibility of using financial statement information to predict the financial stability of a prospective contractor.

The data in the financial statements usually are classified into categories that indicate the firm's liquidity. efficiency, leverage, and profitability. Ratio analysis is the technique most often employed to analyze and evaluate a firm's performance in these categories.

Liquidity Measures

The purpose of liquidity ratios is to determine the ability of a firm to meet its maturing obligations. They attempt to determine whether the firm will have sufficient "current (or liquid) assets" in the form of cash or near-cash assets, that can be converted into cash quickly without loss of value, to pay its "short-term liabilities". Current assets and liabilities are clearly shown on a firm's balance sheet, of course.

"Working capital" is computed by subtracting current liabilities from current assets. Thus, it shows the amount of current assets still available to the firm after all current liabilities are paid. Commonly used liquidity ratios typically express the

amount of current assets or working capital as a ratio of other figures found on the financial statements, e.g., current assets/ current liabilities, working capital/total assets, working capital/ sales, etc.

Efficiency Measures

Efficiency measures provide information regarding a firm's efficiency in using its assets. Efficiency measures are typically expressed as the number of times the assets are turned over. For example, an overall measure of efficiency is the firm's total asset turnover ratio (sales/total assets). Thus, Firm A with sales of $5 million and total assets of $1 million is considered more efficient than Firm B if firm B generates only $4 million of sales with $1 million of assets (5 vs 4 in asset turnover ratios). Other turnover ratios include sales/total liabilities, cost of sales/inventory, credit sales/receivables, etc.

Leverage Measures

The leverage ratios examine the relative contributions that the creditors and owners make to the financing of assets. Creditors expect owners to provide a fair share of equity funds to operate a firm. If the owners provide only a relatively small percentage of total funds, the creditors bear much more risk than they would if owners' equity were substantial. Leverage can be favorable to the owners if the firm is able to earn more on borrowed funds than it pays in interest. Leverage can be unfavorable, however,

if the assets earn less than the interest cost of debt. Commonly used leverage measures include equity/asset ratio, equity/liability ratio, and liability/asset ratio. These ratios are transformations of each other (total assets - total liabilities = equity) and therefore may be substituted for each other to reflect the degree of leverage

Profitability Measures

The objective of profitability ratios is to measure the overall effectiveness of managerial decisions, i.e., to provide a final appraisal of management decisions. Profitability measures, such as return on sales, return on investment, and return on equity, are well known and do not require additional explanation.

Coverage is another category of profitability measure which is closely related to the degree of leverage. Coverage measures examine a firm's ability to earn enough profit to service its fixed payment obligations, primarily interest on debt. The most widely used coverage measure is interest coverage, which is the ratio of a firm's earnings before interest and taxes to annual interest charges.

THE POPULAR Z-SCORE MODEL

The detection of firms facing potential financial disaster is a subject which has been particularly amenable to analysis with financial ratios such as those discussed above. Early studies on bankruptcy prediction centered on identifying financial ratios

that may be used as predictors of bankruptcy.1 In general, ratios measuring profitability, liquidity, and solvency prevailed as the most significant indicators. However, the order of their importance is not clear, as almost every study cited a different ratio as being the most effective indication of impending problems. These shortcomings lead to the development of a multi-ratio bankruptcy model, the well-known the Z-score model.2

The Z-score model is the result of a statistical analysis examining 33 failed firms and 33 healthy firms. Five financial ratios were identified as the most significant in discriminating the failed firms from the healthy ones. The five ratios are: (1) working capital/total asset (WC/A), (2) retained earnings/total assets (RE/A), (3) earnings before interest and taxes/total assets (EBIT/A), (4) market value of equity/total liabilities (MVE/L), and (5) sales/total assets (S/A). A company's financial statements are analyzed and the five ratios are computed to determine a composite score, Z, for the firm according to the following equation:

$$Z = 1.2WC/A + 1.4RE/A + 3.3EBIT/A + 0.6MVE/L + 1.0S/A$$

Firms with Z-scores above 2.99 and below 1.81 are classified as financially healthy and facing bankruptcy respectively. Firms with Z-scores between 1.81 and 2.99 are considered to be in the "gray area" and further fine-tuning is needed to determine the optimal cutoff.

PREDICTING DEFENSE CONTRACTOR BANKRUPTCY

This section describes our efforts to develop a viable contractor bankruptcy prediction model to assist procurement managers in screening out financially weak firms during the source selection stage.

Sample

In order to develop a model suitable for Government contracting, an extensive data search was conducted to gather information about contract default for financial reasons. The following agencies supplied the needed information about contractors which have filed for bankruptcy under either Chapter 10 or 11 of the Bankruptcy Act: Federal Legal Information Through Electronics, Legal Office of the U. S. Army Finance and Accounting Center, and Defense Contract Administrative Service Region (Los Angeles).

The search yielded a significant number of contract terminations for financial reasons. The next step was to gather needed financial data of bankrupt contractors. The needed data are a part of the pre-award survey conducted by DCASMA. The survey is documented using Standard Form 1403. Part of the information from the form is an abstract of the company's latest financial figures, and it is these data that were used in this study.

The ten DCASMAs across the country were requested to supply the financial part of a pre-award survey. Because of the following obstacles, only 26 usable sets of data were collected:

(1) The DCASMAs had pre-award surveys for contractors on

file the past three years only;

(2) The financial part of a pre-award survey was not conducted in some cases;

(3) The pre-award survey file for some contractors could not be located; and

(4) Some DCASMAs were unwilling to release the information, despite the assurance that contractors's identities would not be revealed.

Each of the bankrupt contractors was paired with a financially healthy contractor of approximately the same asset size, thus yielding a total of 52 contractors in the sample. Since some DCASMAs supplied the needed data but refused to release the identities of contractors, match-up by industry could not be done.

Using the Z-Score Model

The popular Z-score model was tested to examine its usefulness as a tool for contracting officers to identify firms facing impending bankruptcy. To use the Z-score model in Government contracting, a few modifications of the model are needed. First, the second variable of the Z-score equation (RE/A) calls for retained earnings, which is not included in the SF 1407. Consequently, this variable had to be omitted from the equation. Second, SF 1407 gives only earnings before taxes (EBT) instead of earnings before interest and taxes (EBIT) used in the equation. To approximate the amount of interest payment, we used the 10% interest rate (used by OMB and DOD), multiplied by the amount of total

liabilities of each firm. Separate tests were conducted using EBT and EBIT to see whether or not interest approximation is necessary. Finally, since firm identity was generally unavailable and many of those with known identity do not have stocks traded in the open market, market values of equity had to be replaced with book values.

Since firms with Z-scores between 1.81 and 2.99 are considered to be in the "gray area", fine-tuning the cut-off point is needed. By using 2.343 as the cut-off for classification of default/nondefault firms, the Z-score model yielded the result shown in Table 1.

Table 1 Z-Score Model Prediction

	Correct Classification	Incorrect Classification
Using EBT:		
Defaulted	58%	42%
Non-defaulted	73%	27%
Using EBIT:		
Defaulted	58%	42%
Non-defaulted	81%	19%

While the accuracy of the Z-score model in classifying default/nondefault contractors may not be overwhelming, it should be noted that every defaulted firm correctly identified by the model represents potential savings to the Government. Granted that misclassifying a non-default firm as unqualified for contract

would mean that the Government would have to award the contract to the next higher bidder, the added cost is unlikely to exceed the potential loss of awarding a contract to a contractor who eventually defaulted. Even if we assume that the cost of misclassification is equal in either case, the application of the Z-score model would still represented a sizable saving to the Government.

The use of the interest approximation to arrive at EBIT appears to improve the performance of the prediction model somewhat, but not significantly enough to proclaim superiority.

In Search of a Better Model

The performance of the Z-score model shown above is not as good as reported by Altman.3 The unique sample of defense contractors and the modifications we made to the model may have contributed to the deterioration of its performance. In order to develop a reliable tool more suitable for Government contracting, an attempt was made to develop a new bankruptcy prediction model.

The task involved several steps. The first was to identify which of the relevant financial ratios would be most useful and what would be the best cut-off for each ratio for default classification. This was done by ordering sample firms on each individual ratio and selecting a cut-off level that minimized misclassifications. This is, of course, analogous to the univariate ratio analysis method used by Beaver in the 1960's.4 For those who feel comfortable with the method, the best cut-off for the most useful ratios are shown in Table 2. For each measure, a ratio below

the cut-off would indicate high potential of financial failure.

Table 2 Result of Univariate Analysis

Measure	Ratio	Cut-off	% Correctly Classified
Liquidity	WC/A	.191	77%
	WC/L	.299	73%
Efficiency	Sales/Assets	2.510	75%
	Sales/Liab.	3.250	73%
Leverage	Equity/Assets	.391	73%
	Equity/Liab.	.364	73%
Profitability	EBIT/Liab.	.221	69%

As mentioned earlier, the ratios in the same category, such as liquidity, may be transformations of each other. Therefore, the similarity in performance is what one might have expected.

The second step was to determine which combination of ratios would result in the best predictability. For this purpose a discriminant analysis was used. It resulted in selecting the following three ratios: (1) equity/assets, (2) working capital/assets, and (3) sales/assets, indicating leverage, liquidity, and efficiency are most indicative of a firm's survivability.

Once the most useful ratios were identified, the final step was to formulate a formal model for default classification. This involved the creation of a "Failure Index".

The Failure Index

Using the cut-off points developed in the univariate ranking, firms were evaluated according to the following criteria:

Ratio	Cut-Off
Equity/Assets	0.391
Working Capital/Assets	0.191
Sales/Assets	2.510

If a firm's financial data exceeded the cut-off for a ratio, a score of 1 was assigned; otherwise the score for the ratio was 0. An index was created by totaling up the scores. Figure 1 provides the scores of those firms examined in this study.

Index Score	% of Failed Firms	% of Healthy Firms
0	58%	8%
1	35%	23%
2	8%	31%
3	0%	38%

Figure 1 Failure Index Distribution

As expected there is a relationship between higher scores and firms' financial health. In our sample there is not a single failed contractor among those with an index of "3", i.e., "healthy" or

all three aspects of financial condition (leverage, liquidity, efficiency). As aspects of financial condition deteriorated, and index scores declined, bankruptcy became increasingly probable. A clear majority of bankrupt contractors have an index score of "0". In short, extreme scores are particularly strong signals.

There was an optimal threshold: If a firm scored two points or better, it was classified as financially healthy, otherwise as a potential default. Overall classification accuracy is 81%, which is better than any other methods discussed above. Table 3 provides some detail concerning classification accuracy. When compared to the results from the Z-score model (see Table 1), the Failure Index model is particularly successful in classifying those firms that actually failed. Since the costs of misclassifying a failed firm (and consequently awarding a contract) are most likely to exceed the costs of misclassifying a healthy firm, the substantial increase in classification accuracy of failed firms by the Failure Index model is significant.

Table 3 Failure Index Model Prediction

	Correct Classification	Incorrect Classification
Actual Status:		
Failed	92%	8%
Non-failed	68%	31%

To see how our Failure Index would stand up in a real world test, the sample was randomly divided into two subsamples. Cut-

offs developed from subsample A were used to classify firms in subsample B. The process was then reversed, using cut-offs from subsample B to classify firms in subsample A. The classification accuracy across the two subsamples averages 79%, virtually identical to the original 81% classification accuracy. This validation process shows that the Failure Index model is superior to any other models discussed above.

FAILURE INDEX AND SOURCE SELECTION

Based on the evidence shown above, we conclude that the "Failure Index" bankruptcy prediction model would be a reliable and valuable tool for contracting officers in determining the qualification of a prospective contractor. The model uses data readily available in Standard Form 1403. The model is intuitively justifiable and easy to apply. Any Administrative Contract Officer capable of conducting a pre-award survey would be capable of applying this model to the evaluation of a potential contractor's financial stability.

Source selection is a crucial step in the acquisition process. The consequence of awarding a contract to an unqualified contractor is costly to the government. Most of the factors considered in the pre-award survey involve fact-finding. Evaluating a potential contractor's financial stability, on the other hand, requires professional judgement about a firm's future operations. As discussed earlier in this paper, the most costly consequence is probably awarding a contract to a contractor who subsequently

declares bankruptcy before completing contract requirements. It is reasonable to say that reliable systematic guidance is needed for contracting officers to evaluate a potential contractor's financial stability. The "Failure Index" model should be a valuable tool for this purpose.

FOOTNOTES

1. W. Beaver, "Financial Ratios as Predictors of Failures," Empirical Research in Accounting, Selected Studies, 1966 supplement to Journal of Accounting Research, January 1967; W. Beaver, "Alternative Accounting Measures as Predictors of Failure," Accounting Review, January 1968; E. B. Deakin, "A Discriminant Analysis of Predictors of Business Failure," Journal of Accounting Research, March 1972.

2. E. I. Altman, Corporate Financial Distress, New York: John Wiley & Sons, 1983.

3. Ibid.

4. See footnote 1.

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